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HARMFUL WASTE GAS REMOVER
[Yuugai haigasu jokyozai]

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Claims

1. A harmful waste gas remover in which the active ingredient is an alkaline earth metal compound that contains moisture.

2. The harmful waste gas remover disclosed in Claim 1 in which the harmful gaseous compound is a volatile inorganic hydrogen compound, such as silane, diborane, or hydrogen selenide, etc.

3. The harmful waste gas remover disclosed in Claim 1 in which the moisture content contained in the remover is 1-25 wt% of the alkaline earth metal compound.

Detailed explanation of the invention

Industrial application field

This invention pertains to a remover for harmful gaseous compounds produced in IC and LSI manufacturing processes.

Prior art and its problems

In the semiconductor industry, which has undergone remarkable growth in recent years, volatile inorganic hydrogen compounds, such as silane, diborane, or hydrogen selenide, etc., produced in IC and LSI manufacturing processes are intensely toxic, and silane, in particular, has properties that cause it to violently react with oxygen in the atmosphere and ignite. Therefore, there is a demand to safely and completely remove the aforementioned harmful substances from the waste gases produced by semiconductor manufacturing processes.

A variety of methods have been proposed in the past for the removal of these harmful substances, but they generally are wet methods in which waste gas containing the harmful ingredients is brought in counterflow contact with a caustic alkaline aqueous solution to absorb and remove the harmful ingredients

in the caustic alkali. However, while this method is characterized by caustic alkaline being relatively inexpensive, due to the increased scale and complexity of the equipment, the difficulty of maintenance due to the corrosive action of the caustic alkali, and the difficulty involved with waste treatment of the alkaline waste solution, etc., a dry removal method is desired.

Dry removal methods include methods in which an aqueous alkaline solution and/or aqueous oxidizer solution is carried on a porous silicate, such as diatomaceous earth, etc., as disclosed in Japanese Kokai Patent Applications Sho 58[1983]-128146, Show 59[1984]-49822, Show 60[1985]-187335, Sho 57[1982]-91719, and Show 60[1985]-175522, etc.

However, since carrying the aqueous solution markedly increases air resistance in those methods that used powdered carriers, they did not withstand use. On the other hand, in those methods that used granular carriers, in cases with a high adherent moisture content, the pores in the porous carrier would fill with water, decreasing the effective surface, and they would exhibit virtually no capacity to recover harmful substances. In contrast, if the adherent moisture was decreased to a suitable amount, the carrier was gradually dried by the contact gas and ultimately completely lost its ability to capture the harmful substance. Therefore, when actually used as a harmful substance capture device, it was indispensable to provide equipment to humidify the waste gas before introducing the waste gas to the harmful substance capture tower, making the equipment more complex and canceling the merits of a dry system.

Purpose of the invention

This invention resolves the aforementioned defects, and its purpose is to provide a harmful waste gas remover with a high capture rate and without large-scale humidifying equipment.

Means to solve the problems

This invention pertains to a harmful gaseous compound remover whose active ingredient is an alkaline earth metal compound that contains moisture.

Oxides and/or hydroxides of any one of the metals selected from magnesium, calcium, strontium, and barium are used as the alkaline earth metal compound. Specifically, oxides and/or hydroxides of calcium are most suitable due to their price and basicity.

It is preferred that the moisture content is 1-25 wt% of the alkaline earth metal compound. The harmful gaseous compound is captured by the alkaline earth metal compound dissolved in this moisture. Consequently, it is undesirable if there is too little moisture as there will be an insufficient capturing capacity.

Volatile inorganic hydrogen compounds, such as silane, diborane, and hydrogen selenide, etc., can be listed as harmful gaseous compounds.

The remover of this invention is obtained by the following manufacturing method. First, water is added to the alkaline earth metal compound, blended, granulated, and dried. A caustic alkaline aqueous solution may be added at this time. Adding a caustic alkaline aqueous solution raises the basicity of the remover, increasing its capturing efficacy.

Next, the dried product is sintered at a temperature of 300-700°C. If the temperature is lower than 300°C, the granules are susceptible to rupture when water has been absorbed, and temperatures higher than 700°C are not preferred as it is difficult to produce a hydroxide of the alkaline earth metal by absorption of moisture. Next, the remover of this invention is obtained by making the moisture content in the sintered product 1-25 wt%. As the method of including a moisture content, e.g., nitrogen gas containing steam is passed through the sintered product.

Application example

This invention will be described in the following application examples.

Application Example 1

Water was added to calcium hydroxide powder, granulated, and dried. The dried product was sintered for 3 h at 500°C to yield approximately 2 mm-diameter lumps of remover. Nitrogen gas containing steam was passed through this remover to include a moisture content of 18.5 wt%. This remover was packed into a 2.5 cm-inside diameter 5 cm column, and nitrogen gas containing 4% by volume silane gas was passed through it at a flow rate of 1 cm/sec. An indicator carrying a $KMnO_4$ aqueous solution was placed at the top of the column and, where the point at which the $KMnO_4$ began to discolor from purple to light brown was deemed the breakthrough point, the gas was sampled and the silane gas concentration measured, wherein some discoloration of the $KMnO_4$ was seen after 40 min and the silane gas discharge concentration at that time was less than 50 ppm.

Application Example 2

A 10 wt% sodium hydroxide aqueous solution was added to calcium hydroxide powder, granulated, and dried. The dried product was sintered for 3 h at 500°C to yield approximately 2 mm-diameter lumps of remover. Nitrogen gas containing steam was passed through this remover to include a moisture content of 20.5 wt%. In addition, this remover contained 6 wt% sodium hydroxide. As the result of silane capture testing performed in the same manner as in Application Example 1, the breakthrough point was at 61 min, and the silane gas discharge concentration was less than 50 ppm.

Application Example 3

Remover obtained in the same manner as in Application Example 1 was packed in a column, and dried nitrogen gas was passed through it for 48 h at a flow rate of 5 cm/sec. The moisture content in the remover after this nitrogen flow was 5 wt%. The results of silane capture testing performed in the same manner as in Application Example 1, using this remover, revealed absolutely no decrease in capturing capacity.

Comparison Example 1

As the result of silane capture testing performed in the same manner as in Application Example 1, using a remover obtained by carrying a 10 wt% sodium hydroxide aqueous solution on 15 g diatomaceous earth, the breakthrough point was reached in 4 min, and the silane discharge concentration at that time was 3.5%.

Comparison Example 2

22 g of the remover obtained in Comparison example 1 were packed in a column in the same manner as in Application Example 1, and dried nitrogen gas was passed through it for 48 h at a flow rate of 5 cm/sec. The moisture content in the remover after this nitrogen flow was 0.8 wt%. The results of silane capture testing performed in the same manner as in Application Example 1, using this remover, showed virtually no capturing capacity.

Comparison Example 3

The results of silane capture testing performed in the same manner as in Application Example 1, wherein the remover was not caused to absorb any moisture by passing nitrogen gas containing steam

through it as in Application Example 2, showed virtually no capturing capacity and the breakthrough point was immediately reached.

Effect of the invention

In the remover of this invention, the alkaline earth metal compound itself functions as a carrier, and consequently, is immediately recovered even if the alkaline earth metal compound in the inherent moisture is consumed by silane, etc. In addition, the remover of this invention contains adsorbed water, and since this adsorbed water is more solidly adsorbed than with a porous silicates, such as diatomaceous earth, etc., it is less susceptible to being released by drying. Therefore, it exhibits a stable capturing capacity even when dried waste gas is flowed through it for long periods of time.